DOCUMENT RESUME

ED 172 854 JC 790 387

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TITLE Science and Social Science in the Two-Year College. Topical Paper Number 69.

INSTITUTION California Univ., Los Angeles. Graduate School of Library and Information Science.; Center for the Study of Community Colleges, Los Angeles, Calif.

SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.; National Science Foundation, Washington, D.C.
PUB DATE Jul 79
GRANT SED-77-18477
NOTE 37p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS College Curriculum; Community Colleges; Course Objectives; Curriculum Design; Curriculum Evaluation; Curriculum Problems; Enrollment; Instructional Media; *Junior Colleges; National Surveys; *Science Courses; *Science Curriculum; *Science Instruction; Science Teachers; Scientific Literacy; *Social Sciences; Student Science Interests; Teaching Methods
IDENTIFIERS Information Analysis Products

ABSTRACT

The findings and conclusions of a study of curriculum and instruction in two-year college social science, science, and science-related technology programs are summarized in three sections. The first selects from 1977-1978 curriculum data which were gathered from catalogs and class schedules of a representative national sample of 175 two-year colleges. Focus is placed on enrollments, and the availability and types of courses for transfer and occupational students, non-science majors, and students in developmental programs, revealing many introductory courses, few remedial courses, and an overall emphasis on serving students already disposed to the sciences. The second section deals with the courses themselves, based upon the results of an instructor survey mailed to 1,275 science and social science faculty members. Selected findings related to various subject areas are provided in terms of numbers of class sections, average class enrollments and completions, course level and objectives, use of instructional media and class activities, grading and examination practices, and instructor characteristics. Traditional teaching methods were found to predominate. The final section reviews the major findings and makes recommendations, stressing the role of the community college in improving science and social science literacy. The instructor survey instrument and responses are appended. (DR)

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TOPICAL PAPER NUMBER 69

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JC 790 387

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by
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July 1979

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The material in this paper was prepared under a grant (Number SED 77-18477) from the National Science Foundation and published pursuant to a contract with the National Institute of Education, U.S. Department of Health, Education and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Prior to publication, the manuscript was submitted to the UCLA Community College Leadership Program for critical review and determination of professional competence. This publication has met such standards. Points of view or opinions, however, do not necessarily represent the official view or opinions of either the UCLA Community College Leadership Program or the National Institute of Education.

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SCIENCE AND SOCIAL SCIENCE IN THE TWO-YEAR COLLEGE

by

Florence B. Brawer and Jack Friedlander

So much has been written in recent years about two-year college occupational programs, financial issues, and community and developmental education efforts that the more traditional so-called transfer offerings have been neglected. At the same time, liberal arts/general education courses are still very much in the mainstream of these institutions. This paper deals with curriculum and instruction in the sciences, social sciences, and technologies in today's junior/community college.

Three characteristics of the comprehensive community college must be considered in order to examine the status of science education in these institutions. The first of these characteristics concerns the multiple missions of the community college. Programs are offered for transfer students in various major fields; for non-transfer students seeking a general education; for students pursuing occupational and technical training; for educationally "underprepared" students needing remedial courses required for entry into the college's transfer or occupational programs; and for non-degree oriented students desiring cultural, recreational, or community interest courses.

A second distinguishing characteristic of the community college is the massive transformation that has occurred recently in the composition of its student body. The percentage of two-year college students enrolled in occupational programs has increased from 13 percent in 1965 to approximately 30 percent in 1970, and then to nearly 50 percent in 1976 (American Association of Community and Junior Colleges, 1976). In his review of occupational enrollment trends in the two-year college, Lombardi notes that "it is not unusual to find colleges, even entire state systems, whose occupational enrollments exceed transfer enrollments" (1978b, p. 1).

In addition to those students who are enrolled in occupational programs, the number of students participating in non-credit courses or programs increased over 100 percent in a one-year period (1.3 million in 1975 to 3.2

million in 1976). The importance of the phenomenal growth of continuing education enrollments in the two-year college becomes evident in the findings that in 1976 there were nearly as many students participating in non-credit courses as there were in credit courses (Lombardi, 1978a).

Another major change that has now occurred in the two-year college--a change that should be taken into account when assessing the viability of the curriculum in that institution--concerns the composition of the student population itself. As so often noted in both the popular and professional press, substantial increases have occurred in the percentage of community college students who fall into one or more of the following categories: over 25 years of age; women students returning after a prolonged absence; senior citizens; part-time students; members of minority groups; and academically "underprepared" students. Persons in three of these groups--women, minorities, and academically "underprepared"--have traditionally been underrepresented in the sciences. Individuals over 25 years of age, senior citizens, and those attending classes part-time are much less likely than traditional full-time students entering the community college directly from high school to follow a prescribed sequence of courses leading to a degree or certificate in the sciences.

A third characteristic of today's community college that differentiates it from the earlier institution is the non-traditional course taking pattern of its students. Much of the curriculum today cannot be viewed in classical terms because it is not a coherent, integrated sequence of courses and experiences. In fact, regardless of how the programs are designed, they are not sequential at all for most of the students who enroll in them. A sizable majority of students do not complete planned programs--vocational, transfer, academic major, or anything else. They drop in and drop out, change majors, begin programs without completing them, use the institution as an ever-present resource (Cohen, 1979).

Given this diversity in programs, students, and educational objectives, it seems important to determine whether the science and social science courses and curriculum are sufficiently comprehensive to meet the multiple missions of today's two-year college. Are the use of media commensurate with contemporary society as well as with the non-traditional students who

typically tend to shy away from reading? Do teaching goals vary among disciplines? How comprehensive is the science curriculum? In what disciplines are remedial courses offered? To what extent are science courses available for non-science majors?

These are some of the questions addressed in this report. The responses are based on data derived from a study of curriculum and instruction in two-year college science and science related technology programs conducted by the Center for the Study of Community Colleges under a grant from the National Science Foundation. The information was obtained from three sources. Extensive literature reviews were conducted of the most important studies reported in each of the 12 disciplines under NSF purview (agriculture, biology, chemistry, earth/space sciences, economics, engineering, interdisciplinary social sciences/anthropology, interdisciplinary natural sciences, mathematics/computer sciences, physics, psychology, and sociology). Curriculum data were gathered for one academic year (1977-1978) from catalogs and class schedules of a representative national sample of 175 two-year colleges, all carefully selected in terms of type of control (public/private), geographic locale, emphasis (comprehensive, technological, liberal arts), organization (multi or single campus) and size. And finally, teaching methods and approaches were ascertained from a random one-thirteenth of science instructors teaching designated courses in the 175 sample institutions.

This paper is divided into three sections. The first deals with the curriculum; the second, with instruction; and the third contains recommendations that are directed to curriculum planners and deans of instruction in two-year colleges, science instructors and chairpersons in both these colleges and the four-year colleges and universities, and agencies concerned with promoting the sciences in higher education.

THE SCIENCE CURRICULUM

Traditionally, the science curriculums in two-year colleges have been geared to transfer students. Sometimes they represent requirements for general education. And frequently the so-called curriculum is cut down to one course because today's two-year college students more often than not fail to complete a prescribed program. If this is the case--if students are exposed to just one course--several issues must be addressed: the place of interdisciplinary courses in lieu of classes in singular disciplines, the commonality of courses between the two-year colleges and the senior institutions to which the students transfer, and the adjustment of courses for students with inadequate academic preparation. All these issues--and more--demand consideration.

Method

The data were obtained by counting all science and social science courses and class sections in the 175 sample colleges' class schedules for Spring 1977 through Winter 1978 (summer session excluded) for each of the disciplines under NSF purview. These courses were also grouped into subject area categories within each discipline. For example, courses were placed in a particular category on the basis of their content (e.g., general biology, botany, microbiology, zoology); level (e.g., introductory, advanced); and the population for whom the courses were primarily intended (e.g., students in science, occupations, non-science, remedial). Courses were omitted from this study if they did not carry college credit, if they were offered as independent study, or if they did not focus primarily on a particular science discipline. (For a full treatment of the methodology employed see ERIC document by Hill and Mooney.)

Results

The several disciplines within the sciences are represented differentially in the two-year college curriculum. During 1977-78 over 97 percent of the colleges offered at least one course in sociology, economics, psychology, mathematics, and chemistry. Over 85 percent of the colleges offered at least one course in biology, physics, interdisciplinary natural

sciences, and engineering sciences and technologies. A substantially smaller percentage of colleges listed a course in earth/space (79%), agriculture (61%), anthropology (54%) and/or in an interdisciplinary social science (40%).

Courses for Transfer Students

Well over 90 percent of the courses and class sections offered in the social sciences (i.e., anthropology, economics, interdisciplinary social sciences, psychology, sociology) are designed to duplicate lower division classes found in four-year colleges and universities. Most of the remaining social science courses are non-technical, non-theoretical introductory surveys that are intended primarily for students who do not plan to transfer to a four-year institution.

Outside of the general introductory survey course, the range of transfer-oriented courses available to students at most community and junior colleges in 1977-78 was very limited. To illustrate, while over 90 percent of the colleges offered a transfer-oriented introductory course in sociology, less than 20 percent of the institutions listed a course in either social institutions, sociology of groups, or on a special topic. Similarly, while close to 90 percent of the colleges offered a transfer-oriented introductory course in psychology, less than 40 percent offered a course in such areas as personality, abnormal psychology, social/industrial psychology, and contemporary issues. Opportunities to take a variety of social science courses offered across a wide range of content areas is just not available in the curriculum of most two-year colleges.

Just over 70 percent of the sciences and technologies (agriculture, biology, chemistry, engineering, earth and space, math, physics, interdisciplinary natural sciences) are designed for science majors and students in science-related occupations. If we exclude mathematics from this category, the number would exceed 80 percent.

The areas with the highest concentration of courses for majors are engineering sciences and agriculture where all but five percent of the offerings are designed specifically for students in those fields. This is followed by physics, chemistry, and biology, with over 80 percent of the

effort directed toward students majoring in a science area or in a science-related occupation.

Enrollments

Enrollment figures reflect the curriculum. Those disciplines offered in nearly all the colleges have most of the students. As Table 1 indicates, 29 percent of all students enrolled in the sciences are in mathematics courses. The social science enrollments far exceed those in natural sciences. The interdisciplinary courses have the broadest appeal but the fewest students. (Total enrollment figures for the nation are extrapolated from the 175 college sample.)

As with the social sciences, the range of transfer-oriented science courses available to students at most two-year colleges is very limited beyond the basic introductory courses. For example, a student interested in biology who wished to enroll in such courses as genetics, human biology, bacteriology, or embroyology would only be able to do so at less than 15 percent of the colleges.

The limited variety of specialized science and social science courses found at most two-year colleges points to a dilemma that must be faced by administrators of these institutions. If these colleges were to offer essential advanced courses in their transfer and technical programs for their high aptitude students, enrollments in many of these courses would be below average since only a small percent of the students in community colleges stay for a second year of study and less than 10 percent of the student population receives the associate degree in any one year (Cohen and Lombardi, 1979). On the other hand, if two-year college administrators do not provide the courses and programs needed by high aptitude students in transfer programs, these students will enroll in a neighboring four-year institution. In a time of declining enrollments, such institutions will greet these individuals with open arms. This loss of high aptitude students will serve to reduce further the viability of transfer programs in two-year colleges.

TABLE 1

THE SCIENCES IN AMERICAN TWO-YEAR COLLEGES
IN ACADEMIC YEAR 1977-1978

	Course Enrollments by Discipline	Percent of Total Enrollments in the Sciences	Number of Class Sections Offered During the Year	Percent of Total Science Class Sections
Agriculture	260,000	2	10,000	3
Biology	1,390,000	13	36,000	11
Engineering	890,000	8	38,000	11
Mathematics	3,080,000	29	111,000	33
Chemistry	530,000	5	18,000	5
Earth/Space	410,000	4	13,000	4
Physics	265,000	3	11,000	3
Interdisciplinary Natural Sciences	240,000	2	9,000	3
Anthropology	185,000	2	6,000	2
Interdisciplinary Social Sciences	120,000	1	4,000	1
Psychology	1,530,000	15	40,000	12
Sociology	980,000	9	28,000	8
Economics	665,000	6	19,000	6

Courses for Occupational Students

Over half of the credit enrollments in community and junior colleges are in occupational courses. Yet, an examination of class titles and course content descriptions revealed that relatively few social science courses were designed especially for students in occupational programs. This was confirmed in companion studies of instructors where 96 percent of the social science faculty noted that their courses were originally designed as parallel to a lower division course at a four-year institution (Cohen and Hill, 1978). Thus, if students in an occupational program desired to take a social science course, they would have to enroll in one intended primarily for those in academic degree programs.

Our definition of science courses for occupational students included those offerings intended primarily for students in non-science related occupational programs. Inspection of the course descriptions found in college catalogs and class schedules reveals that, with the exception of engineering and earth and space sciences, each of the science areas has at least one course that is designed especially for students in an occupational program. Overall, about 16 percent of all class offerings and 13 percent of all class sections offered in the sciences are devoted exclusively to students in occupational areas. Examples of courses in this category include Physics for Allied Health and Other Biology-related Occupations, Physics for Engineering Technology and Related Occupations, Chemistry for Technology Students, and Statistics for Technological Fields.

Two additional observations concerning science courses for occupational students should be noted. The first of these is that there is a paucity of science courses designed primarily for students in non-science occupational programs. Thus, if these students wish to enroll in a science course they must do so in a general introductory course intended for all students. The second point is that there are few science courses intended for students in an occupational area not directly related to the field of study. Examples of such courses would be biology for engineering students, engineering for students in allied health occupations, and physics for students in agricultural-related programs.

Courses for Non-science Majors

At most two-year colleges the number of students participating in courses for reasons of personal enrichment, career exploration, or occupational development is often much greater than the numbers of students actually pursuing academic degrees and occupational certificates. It would seem that general and continuing education students are much more likely to enroll in science and social science courses that are non-technical, applied, and perceived as being immediately relevant than to enroll in courses more technical, theoretical, and somewhat abstract. Thus, two indicators of the extent to which science departments are attempting to attract non-degree oriented students to enroll in their classes are the availability of general introductory courses in an area designed especially for majors outside the science and social science fields, and the availability of non-technical courses that focus on current issues, problems, or special topics in a science or social science area.

Not surprisingly, our study substantiates the observation that a relatively low percentage of two-year colleges offered a general introductory course in a science or social science area intended primarily for non-majors or non-degree oriented students. For example, while 94 percent of the colleges offered principles of sociology--a course intended primarily for students planning to transfer to a four-year institution--only seven percent offered a more general introductory sociology course designed for non-sociology majors who wish to fulfill a general education requirement or for students who do not seek a degree but wish to learn more about the field. Similar differences in the percentage of colleges that offered introductory courses intended primarily for students in science-related fields and non-science areas were found in economics (93% vs. 33%), psychology (87% vs. 18%), zoology (67% vs. 6%), botany (66% vs. 10%), physics (77% vs. 37%), chemistry (73% vs. 55%), and biology (73% vs. 55%). Only a small percentage of colleges in the sample offered introductory courses designed primarily for non-science, non-technology students in the remaining areas studied.

At most, the two-year colleges' range of science and social science courses that focus on current issues, problems, and special topics available to general education and continuing education students is limited. This is because the number of courses offered in these areas is small to begin with and, of the courses that non-degree oriented students may find especially attractive, many specify a prerequisite for entry.

Courses for Students in Developmental Education Programs

Many students attending community colleges are academically underprepared. While figures on the number of students who fall into this category are not readily available, Lombardi (1979) estimates that the remedial student population will soon reach 50 percent of the total enrollment for credit. This estimate would be substantially higher if students who are eligible for remedial programs but do not participate were also considered.

Inspection of the catalog descriptions of science and social science offerings reveals that, with the exception of mathematics, academic departments do not frequently address courses to the learning needs of this growing segment of the two-year college student population. For example, a special class designed to prepare students to enter an introductory course in a specific discipline is found in only three areas of study outside of mathematics. A preparatory course in chemistry is available in 26 percent of the colleges, while less than ten percent of the colleges offer such a course in physics and interdisciplinary natural sciences. Thus, while it is possible to start some science and social science courses at a level below college, remedial courses are still offered primarily only in English and mathematics. Over one-third of the class sections in mathematics are offered at a level below college algebra. Nearly all the two-year colleges offer an elementary course in at least one of the following areas: pre-algebra, introductory algebra, geometry, intermediate algebra, and applied college mathematics for students in technology-related programs.

In summary, the curriculum in each of the disciplines is directed primarily towards those students who are already predisposed to the sciences, an emphasis that would be appropriate if student interest in science were high. Unfortunately, such is not the case. Student interest in science is

low and recent reports show that a trend away from the sciences is likely to accelerate in that enrollments in high school science courses are decreasing, particularly those in chemistry, physics, and biology. Thus the science curriculum as it is now presented is not likely to appeal to the majority of students attending the two-year college.

INSTRUCTION IN THE SCIENCES

The previous section dealt with science curriculum--the array of courses offered, the proliferation of introductory courses, the availability of advanced courses, and the sparcity of remedial courses. This section is concerned with the classes themselves--how they are taught, the media that are used, the grading practices employed, and the goals instructors hold for their students. These data were obtained from responses to an eight-page Instructor Survey mailed to 1,275 faculty members teaching science or science related technology courses in our sample of 175 two-year colleges. The 85 percent response rate to this questionnaire and the careful selection procedures employed enhances the reliability of this information as it pertains to all types of community/junior colleges throughout the country. The survey form and responses are recorded in the Appendix.

What, then, is happening in the sciences in two-year colleges? How much reading is required in what courses? What would it take to improve these courses? What differences pertain to the various disciplines examined?

Of the NSF related disciplines with which these colleges are concerned, the largest numbers of class sections are in mathematics. Thus, since the instructors were sampled according to the class sections they were teaching in fall 1977, mathematics instructors were most highly represented. In fact 31 percent of the respondents taught some form of mathematics. Biology instructors were next, 13 percent of the population, followed by the psychology and engineering faculty who represented 11 percent each. Then, in descending order, were the instructors of sociology, chemistry, economics, earth/space, physics, agriculture, and finally, anthropology and interdisciplinary social and natural sciences, each of which encompassed only 2 percent of the total respondents.

Table 2 presents an overview of the relative number of science courses for the 1977-1978 academic year. Each of the disciplines aggregate several categories--biology, for example, includes introductory and advanced courses, botany, zoology, human, microbiology, entomology, economy and environmental, and a small catchall group, "other". Psychology encompasses courses in

TABLE 2

SCIENCE INSTRUCTION IN THE TWO-YEAR COLLEGES, 1977-78 ACADEMIC YEAR

	Percent of Colleges Listing this Type Course		Percent of Total Science Courses Listed on Schedule	Percent of Total Science Sections Listed on Schedule	
	in Catalog	in Class Schedule		Lecture	Laboratory
	(n=175)	(n=175)	(n=15,084)	(n=49,275)	(n=16,550)
Agriculture and Natural Resources	67	61	6	3	6
Anthropology and Interdisciplinary Social Sciences	79	67	3	3	
Biology	100	100	13	11	33
Chemistry	97	97	8	5	17
Earth/Space	84	79	5	4	4
Physics	91	89	6	3	10
Economics	99	99	4	6	
Engineering	87	86	20	11	30
Interdisciplinary Natural Sciences	93	89	4	3	
Mathematics and Computer Sciences	99	99	22	33	
Psychology	100	99	6	12	
Sociology	100	100	4	8	

elementary, general, developmental, abnormal, social-industrial, personality and adjustment, experimental, educational, contemporary issues, and physiological.

These 1,275 selected class sections enrolled an average of 16.3 male and 15.5 female students, but that number varies considerably with the type of course considered. On average, economics enrolls the highest number of males (21), and biology enrolls the most female students (26), an artifact, undoubtedly, of the many students enrolled in nursing and allied health programs. Conversely, biology enrolls the lowest average of males (13), and engineering classes are lowest in female representation with an average of 4. Initial enrollment figures as well as the number of students receiving course grades are presented in Table 3.

The larger the class section, the greater the chance that it was taught by instructors who had the most teaching experience. To illustrate, whereas faculty with less than two years experience had an average of 29 students per section, faculty with over ten years of teaching experience enrolled an average of 37 students. Predictably, part-time instructors also tend to teach smaller classes.

These classes were characterized in a variety of ways--from college parallel to adult education and personal upgrading--and frequently, they were seen as fitting more than one level and intended for more than one type of student group. Sixty-eight percent of the science classes sampled were described as parallel to lower division courses at transfer institutions; 34 percent were designed for non-science transfer students; 35 percent for occupational students majoring in science technologies; and 10 percent for occupational students in allied health fields. (These figures add up to more than 100% because of multiple designations.) As noted previously, over one-third of the mathematics classes were designed for students in so-called developmental education or remedial programs, but few of the other fields claimed such a remedial emphasis.

Moving now to the goals that science instructors hold for their students, we note considerable variation among the disciplines. For example, when offered one set of four qualities they might want their students to achieve, 60 percent of the instructors selected as their major goal,

TABLE 3

SCIENCE CLASS SECTION SURVEY: ENROLLMENTS, SPRING 1978

Average initial enrollments per class for all science courses.....32

Average number of students who completed the course and received grades...25

Average by discipline:

	Initial Enrollments	Number Receiving Grades	Percent Completed
Agriculture	26	23	88
Anthropology and Interdisciplinary Social Sciences	30	24	80
Biology	39	31	79
Chemistry	30	24	80
Earth/Space	34	26	76
Economics	35	28	80
Engineering	24	19	79
Interdisciplinary Natural Sciences	26	21	81
Mathematics and Computer Sciences	28	20	71
Physics	24	21	88
Psychology	39	32	82
Sociology	35	29	83

"Apply principles learned in course to solve qualitative and/or quantitative problems". Although the total number is well over half, however, it covered a range from 20 percent of the integrated science instructors to 86 percent of the teachers of mathematics. On the other hand, "Understand/appreciate interrelationships of science and technology with society" was the first choice of over 65 percent of the anthropologists, earth/space instructors, and teachers of integrated science courses. Except for engineers, few instructors were concerned with developing "Proficiency in laboratory methods and disciplinary techniques" and practically no one selected the ability to "Understand scientific research literature". It appears that these goals alone would not only distinguish between disciplines but would also clearly differentiate two-year college instructors from their colleagues in four-year colleges and universities.

The second set of four desired qualities equally supported the notion of relating classroom knowledge to real world systems and problems, and appreciating and understanding the scientific method. Here again, however, the disciplines varied. Less than one-fourth of the chemists chose "Relating knowledge to real world systems", while over 60 percent of the anthropologists, economists, integrated science instructors, sociologists, and psychologists selected that goal. Conversely, chemists supported the understanding of concepts more than other disciplinary groups.

Over 47 percent of the respondents to the third set of desired ends wanted their students to develop the ability to "Think critically". "Understand self", not strongly supported by faculty in the physical sciences and technologies, was, as one would expect, an important goal for the social and behavioral scientists--anthropologists, sociologists, and psychologists. Interestingly, the selection of goals did not differentiate between full-time and part-time teachers nor among those instructors who did and did not hold the doctorate. Similarly, they failed to discriminate among instructors in large, medium or small colleges, or colleges in urban, suburban, or rural areas. The disciplines appear to be more powerful than the institutions themselves, and the indoctrination toward the disciplines that instructors experience in their own academic years appears pervasive.

Disciplinary differences also appear in the establishment of prerequisites for the various course sections. Whereas 42 percent of the faculty noted the presence of a prerequisite for the course they were teaching, the range among fields was wide. Only 10 percent of the earth/space and integrated science respondents specified prerequisites, while over half of the chemists, engineers, mathematicians, and physicists so indicated; physics was highest of all (78%).

One rather consistent dimension for all disciplines related to the allocation of class time. The total group of science instructors lectured an average of 45 percent of the time and class discussion accounted for the next largest block (15%). Expectedly, laboratory experiments by students varied considerably by discipline. Less than 10 percent of the class periods were spent on any one of the following: guest lectures, student verbal presentations, viewing and/or listening to media, simulation/gaming, quizzes and exams, field trips, and lecture/demonstration experiments.

The use of media is frequently advocated. But what instructors use what devices? What are the disciplinary differences in the uses of films, tapes, and other forms of media? Films, overhead transparencies, and maps, charts, illustrations, displays were used either frequently or occasionally by half of our respondents. Except for mathematics, instructors in all disciplines--and especially the social scientists--rely to some extent on films. Overhead transparencies and slides are the two media most likely to be developed by the instructors themselves. Almost half the responding physicists occasionally employed single concept film loops, while three-fourths of these same instructors never used filmstrips. Slides are frequently used by well over a third of the earth/space instructors and occasionally by almost half the biologists, about three-fourths of whom also utilize overhead transparencies. Few people elect to use broadcast or closed circuit television in their class work. Incidentally, the years instructors have spent in teaching do not relate to their use of media, nor, as found in a previous study of faculty (Cohen and Brawer, 1977), to the degree of satisfaction they feel for their work.

Maps, charts, illustrations and displays are also treated differentially among the various disciplinary groups. Less than ten percent of the instructors of integrated sciences, mathematics, sociology, and psychology employ these media, as contrasted with 63 percent of the earth/space faculty who do so. And three-dimensional models, designated by about 37 percent of the

respondents, are utilized predominantly by chemists, biologists, and earth/space instructors. Natural preserved or living specimens were extensively featured in biology and agriculture classes, but did not appear in any other disciplines. Scientific instruments are also employed by a little under 40 percent of the instructors--here, again, chiefly by the natural scientists. Full-time faculty were more likely than their part-time colleagues to utilize instructional aids.

Moving from media to the reading that is required of students, we find that almost all (95%) of the respondents designate textbooks. Other reading materials, noted in descending order, are syllabi and handout materials (62%), laboratory materials and workbooks (44%), journal and/or magazine articles (25%), reference books (22%), collections of readings (14%), newspapers (11%), and problem books (10%).

Between 10 percent and 25 percent of our respondents used in their classes such written materials as problem books, newspapers, reference books, collections of readings, and journal and/or magazine articles. Approximately 80 percent of the biology, chemistry, and physics instructors used lab materials and workbooks. Over half the anthropology and agriculture classes utilized journal and/or magazine articles, which were found to be "useful" by 45 percent of the economics instructors. Full-time faculty were more likely to use workbooks and syllabi than were part-timers.

The average number of pages required of students in all disciplines was 307.8. Again, the social scientists stand apart, tending to require more reading than instructors of mathematics or other sciences. Full-time instructors require more reading than part-timers, a finding that corroborates data we obtained from humanities instructors in a different sample who responded to this same question (Cohen, 1978). Similarly, people with doctorates require more reading than those who do not hold advanced degrees. Almost two-thirds of the respondents say they are well satisfied with their materials; others would change them. Very few of the materials are prepared by the instructors themselves--only the anthropologists did any significant amount of self preparation.

Awareness of the person who is responsible for selecting class materials offers an interesting commentary on the control of instructional practices.

Over half the instructors in anthropology/interdisciplinary social sciences, agriculture, chemistry, earth/space, integrated sciences, and psychology had total say in selecting their textbooks. Yet, only 21 percent of the math instructors had total say, and 35 percent had no say in textbook selection. Over half of the total group of instructors, however, had complete control in selecting laboratory materials and workbooks; and over 80 percent were totally responsible for their collections of readings, reference books, journal and/or magazine articles, newspapers, and syllabi and handout materials.

In terms of classroom activities, the disciplinary groups within the sciences are somewhat disparate. The social scientists--anthropologists, sociologists, and psychologists--emphasize papers written outside of class considerably more than do the mathematicians or physical scientists. Sociologists tend to assign research reports for more than 25 percent credit more than any other discipline; engineers and mathematicians stress homework more than any other instructors; and chemists, engineers, mathematicians, and physicists emphasize laboratory reports. Although instructors recommend that their students attend a wide range of events, these are rarely required. Field trips were mandated by 26 percent of the agriculture instructors while television programs, outside lectures, and tutoring were recommended by about one-third of the faculty.

Now, about grading practices. Only two activities were widely used in determining over one quarter of the student's grade: quick-score objective tests (used by 60% of the instructors) and essay exams (used by 41%). In their exams, most instructors ask their students to demonstrate an acquaintance with disciplinary concepts but again, the disciplines are split. The mathematicians among our respondents (88%) strongly urge mastery of a skill while few of the anthropology/interdisciplinary social science and sociology instructors feel the importance of such skill development. In descending order, the qualities on which instructors report they test their students are: acquaintance with concepts of the discipline (83.1%), mastery of a skill (51%), ability to synthesize course content (46.5%), understanding the significance of certain works, events, phenomena, and experiments (44.9%),

recall of specific information (42.7%), and relationship of concepts to student's own values (24%).

Multiple choice and true/false exam items were most often emphasized by all except the mathematics and physics instructors. Solution of mathematical type problems where the work must be shown was important for the natural scientists--chemists, engineers, mathematicians and biologists. Actually, grading practices are fairly standardized, with 74 percent of the class sections graded A B C D F, and 15 percent graded A B C D /no credit. A B C/ no credit is used sparingly and pass/fail and pass/no credit hardly exist. Private colleges used A B C D F almost exclusively, and medium-sized urban colleges showed the most flexibility in grading schemes.

The instructors' relationship to their colleges may well be reflected in their classroom activities--how they teach, what they deem important for their students to know, how they grade. The kinds of assistance available to them, the advantage they take of these aids, and the things they sense would make their courses better all provide ways of looking at both the student and the college climate. Clerical help was most available and most utilized. One-third of the instructors used the help of tutors, media production, and library assistance. One-fourth had lab assistants available to them, and 81 percent of this group utilized this help. More assistance was available to full-timers, but faculty in private colleges had significantly less available assistance than either full- or part-time faculty in public institutions.

Instructors were offered a list of possible items that might make their courses better. Their overwhelming first choice (53%) was "Students better prepared to handle course requirements", with "Instructor release time to develop course and/or material", and "Availability of more media" close behind (both around 36%). Less than one percent of the faculty wanted fewer or no course prerequisites, as contrasted with the 31 percent who desired stricter prerequisites. Professional development opportunities (25%) and better lab facilities (21%) were also widely noted. Smaller classes were desired by 29 percent of the teachers (almost 40% in the social sciences); only 8 percent wanted larger classes. Sixty-three percent of instructors at private, liberal arts colleges felt they needed more media, while part-timers

wanted more freedom to choose materials and more interaction with their colleagues.

Now, some demographic data about our respondents. The largest cluster (56%) had taught 3-10 years; 13 percent taught less than three years; and 31 percent, 11 years or more. Expectedly, full-timers, who represented over 78 percent of the science faculty, tended to have much more teaching experience than part-timers. Around 15 percent of the class sections in the sciences are taught by people with doctorates (as compared with 19% of the sections in the humanities). Only six percent of the science instructors are employed in a research or industrial position directly related to their teaching field--but of this small coterie, 79 percent had been so involved for over 15 years.

This, then, is a profile of science instructors in two-year colleges. In general, they are quite traditional in their teaching approach and as a rule, differences that pertain among them tend to be tied to disciplines rather than to types of institutions. In other words, intra-college differences still appear to be greater than inter-college differences, and disciplinary disparities among people in various science fields seem basic and pervasive. Is this the best way to introduce science to the masses? If instructors want to make science more appealing to a greater group of students and to increase science literacy among more people, then they might think about crossing disciplinary fences and adopting other approaches to their teaching.

DISCUSSION AND RECOMMENDATIONS

By proclaiming that they have something to offer to all people according to their needs and abilities, community colleges are obliged to provide adequate and meaningful instructional offerings to their constituents. These colleges must do several things and adopt a number of approaches in order to fulfill the objectives and promises of the open-door policy.

For example, two-year colleges should provide transfer students with science and social science courses that will prepare them just as their counterparts at the universities are prepared. In this way, potential transfers can enter more advanced courses in the field with the same background material held by their university peers. Further, non-transfer students (i.e., occupational, general education, continuing education) should be afforded the opportunity of taking a science or social science course suitable for their abilities and interests. One basic reason for designing separate courses for different student groups is that many non-transfer students are neither willing nor capable of successfully completing a traditional transfer course and will either avoid it or, if forced by requirements to enroll, will fail or drop out (Apsler, 1967).

A major recommendation emanating from this study is for faculty members in the sciences and social sciences to identify the aspects of their subjects that students in each of the colleges' constituency groups would find valuable, and then design distinctive courses that would satisfy their apparent learning needs. In other words, the two-year colleges should present science and social science courses appropriate for students in transfer, occupational, remedial, and personal enrichment programs, appropriate in terms of course context, media and other instructional aids, types of presentation of material, and selection of reading material. Since most community college instructors have some autonomy in selecting media and materials, a certain amount of classroom flexibility is feasible. And this flexibility must be determined by the types of students to whom the courses are directed.

Flexibility is implemented at several community colleges in the area of mathematics. Here we found mathematics courses designed specifically

for students in various major fields in the liberal arts, social sciences, education, business, biological sciences, allied health, and agriculture. Similarly, several colleges offered separate courses in developmental mathematics for students in general education programs, for those interested in business, and for students in applied and technical fields of study.

The fact that mathematics courses were found in most two-year college curriculums is due to several reasons. First, faculty members in a variety of fields view some degree of understanding in mathematics as essential for success in their disciplines. Second, many departments offer mathematics courses designed especially for their majors. For example, it is not uncommon to find at the same institution an introductory statistics course offered in business, economics, health sciences, and psychology. Third, students in many science, social science, and occupational areas are strongly encouraged to take a mathematics course as part of their degree or certificate program. The point here is that the level of scientific literacy among all segments of the two-year college population is largely contingent upon whether faculty members are convinced that students interested in their field of study will benefit substantially by being exposed to the area of science under question.

Scientific literacy is also inextricably interwoven with reading ability. Identification of students with reading problems, the use of reading tests as entry level prerequisites to courses, and reading remediation for students who require this type of intervention may all be necessary before students can acquire even the basic rudiments of scientific knowledge.

Instructors can also encourage science awareness by stressing the relationship of their discipline to society and to real world issues. Interdisciplinary courses that focus on important themes may provide just enough of a stimulus to students who would otherwise shun science courses. For example, anthropology is conspicuously absent from private, small public, and technical colleges. An interdisciplinary social science course that incorporates anthropological concepts and methods and is related to current issues would present students with at least an introduction to this subject and possibly an awareness of their own cultural background.

Identifying topics in a particular area of science for students whose primary interests lie elsewhere is another way of stimulating scientific awareness. For example, history students might appreciate a course on

economics of the city; students in allied health and nursing might find a course on economics for the health professions to be very valuable; the economics of auto mechanics would seem like a natural course to take for those preparing for that trade. Who can deny the appeal of a course in business economics for students in business administration; a course in consumer economics as a medium for presenting the basic skills to students in remedial education programs; or a class in the economics of the stock market for continuing education students?

In summary, by virtue of their size and the diversity of the population they serve, community and junior colleges play a key role in determining the level of science and social science literacy in this country. The challenge facing the faculty in these fields is to develop distinctive courses and programs that will make these studies an attractive elective for all categories of students--transfer, occupational, and continuing education. Knowledge of the sciences and the social sciences is becoming increasingly important in enabling one to function effectively in this society. For too many students, the community college represents the last opportunity to receive formal instruction in those areas of knowledge that are so crucial for the individual to function effectively in our society today. Instructors, curriculum planners, counselors, and other two-year college administrators have an obligation to provide exposure to the sciences to the wide range of students in their institutions.

APPENDIX

Responses to the Survey

Following are the responses to the survey form that was completed by 1,275 instructors in 175 colleges. Percentages do not always add up to 100 because of rounding and no response.

1. Your college's class schedule indicated that in Fall, 1977 you were teaching:

   _____ (Course) _____ (Section)

2. Approximately how many students were initially enrolled in this class?

	Percent
Males	16.3
Females	15.5

3. Approximately how many students completed this course and received grades? (Do not include withdrawals or incompletes.)

	Percent
Males	12.8
Females	12.5

4. Check each of the items below that you believe properly describes this course:

	Percent
a. Parallel or equivalent to a lower division college level course at transfer institutions	68
b. Designed for transfer students majoring in one of the natural resources fields (e.g., agriculture, forestry) or an allied health field (e.g., nursing, dental hygiene, etc.)	27
c. Designed for transfer students majoring in one of the physical or biological sciences, engineering, mathematics, or the health sciences (e.g., pre-medicine, pre-dentistry)	33
d. Designed for transfer students majoring in a non-science area	35
e. Designed for occupational students in an allied health area	19
f. Designed for occupational students in a science technology or engineering technology area	30
g. Designed as a high school make up or remedial course	12
h. Designed as a general education course for non-transfer and non-occupational students	17
i. Designed for further education or personal upgrading of adult students	35
j. Other (please specify)	6

5a. Instructors may desire many qualities for their students. Please select the one quality in the following list of four that you most wanted your students to achieve in the specified course.

	Percent
1) Understand/appreciate interrelationships of science and technology with society	27
2) Be able to understand scientific research literature	2
3) Apply principles learned in course to solve qualitative and/or quantitative problems	61
4) Develop proficiency in laboratory methods and techniques of the discipline	8

b. Of the four qualities listed below, which one did you most want your students to achieve?

	Percent
1) Relate knowledge acquired in class to real world systems and problems	48
2) Understand the principles, concepts, and terminology of the discipline	43
3) Develop appreciation/understanding of scientific method	2
4) Gain "hands-on" or field experience in applied practice	6

c. And from this list, which one did you most want your students to achieve in the specified class.

	Percent
1) Learn to use tools of research in the sciences	9
2) Gain qualities of mind useful in further education	33
3) Understand self	9
4) Develop the ability to think critically	47

6a. Were there prerequisite requirements for this course?

	Percent
Yes	42
No	57

b. IF YES: Which of the following were required?

		Percent
1) Prior course in the same discipline taken in:	high school	23
	college	36
2) Prior course in any science taken in:	high school	5
	college	7
3) Prior course in mathematics taken in:	high school	44
	college	33
4) Declared science or technology major		9
5) Achieved a specified score on entrance examination		13
6) Other		11

7. Over the entire term, what percentage of class time is devoted to each of the following:

	Percent
a. Your own lectures	45
b. Guest lecturers	1
c. Student verbal presentations	3
d. Class discussion	15
e. Viewing and/or listening to film or taped media	4
f. Simulation/gaming	5
g. Quizzes/examinations	10
h. Field trips	1
i. Lecture/demonstration experiments	3
j. Laboratory experiments by students	11
k. Laboratory practical examinations and quizzes	2
l. Other	5

8. How frequently were each of the following instructional media used in this class?

	Frequently used	Occasionally used	Never used	Developed by self or other faculty member
a. Films	9	40	44	2
b. Single concept film loops	1	13	68	1
c. Filmstrips	3	16	64	2
d. Slides	8	22	54	40
e. Audiotape/slide/film combinations	3	16	62	21
f. Overhead projected transparencies	20	27	39	41
g. Audiotapes, cassettes, records	3	17	62	17
h. Videotapes	3	17	63	18
i. Television (broadcast/ closed circuit)	1	8	72	11
j. Maps, charts, illustrations, displays	20	36	31	23
k. Three dimensional models	10	27	47	12
l. Scientific instruments	18	21	44	2
m. Natural preserved or living specimens	9	7	64	12
n. Lecture or demonstration experiments involving chemical reagents or physical apparatus	10	17	54	19
o. Other	6	3	1	24

9. Which of the following materials were used in this class?

Check	Materials Used	How many pages in total were students required to read?	How satisfied were you with these materials?			Did you prepare these materials?		How much say did you have in the selection of these materials?			
			Well-satisfied	Would like to change them	Definitely intend changing them	Yes	No	Total say	Selected them but had to verify with a chairperson or administrator	Was member of a group that selected them	Someone else selected them
95	Textbooks	308	62	24	12	2	92	42	9	25	22
44	Laboratory materials and workbooks	101	60	26	9	38	56	59	6	20	14
14	Collections of readings	126	73	14	4	28	63	82	2	9	4
22	Reference books	114	80	10	2	1[illegible]	[illegible]	81	1	8	6
25	Journal and/or magazine articles	23	84	6	3	14	74	86	1	3	5
11	Newspapers	22	78	6	4	17	71	83	1	3	6
62	Syllabi and handout materials	29	79	12	3	88	7	84	3	6	2
10	Problem books	90	69	14	11	15	76	50	4	20	21
8	Other	121	81	10	0	53	41	69	3	12	11

10. Please indicate the emphasis given to each of the following student activities in this class.

	Not included in determining student's grade	Included but counted less than 25% toward grade	Counted 25% or more toward grade
a. Papers written outside of class	50	25	9
b. Papers written in class	62	8	5
c. Quick-score/objective tests/exams	14	15	60
d. Essay tests/exams	30	15	41
e. Field reports	61	9	2
f. Oral recitations	58	17	2
g. Workbook completion	58	14	4
h. Regular class attendance	53	32	3
i. Participation in class discussions	51	33	2
j. Individual discussions with instructor	70	9	1
k. Research reports	58	14	3
l. Non-written projects	63	8	2
m. Homework	45	32	7
n. Laboratory reports	49	17	10
o. Laboratory unknowns and/or practical exams (quantitative and qualitative)	54	11	7
p. Problem sets	53	18	5
q. Other	1	3	4

11. Examinations or quizzes given to students may ask them to demonstrate various abilities. Please indicate the importance of each of these abilities in the tests you gave in this course.

	Very important	Somewhat important	Not important
a. Mastery of a skill	51	28	17
b. Acquaintance with concepts of the discipline	83	13	1
c. Recall of specific information	43	49	6
d. Understanding the significance of certain works, events, phenomena, and experiments	45	34	17
e. Ability to synthesize course content	47	39	10
f. Relationship of concepts to student's own values	24	36	36
g. Other	3	0	0

12. What was the relative emphasis given to each type of question in written quizzes and examinations?

	Frequently used	Seldom used	Never used
a. Multiple response (including multiple choice and true/false)	50	20	28
b. Completion	25	32	38
c. Essay	31	23	42
d. Solution of mathematical type problems where the work must be shown	49	15	31
e. Construction of graphs, diagrams, chemical type equations, etc.	26	30	39
f. Derivation of a mathematical relationship	12	27	54
g. Other	5	0	0

13. What grading practice did you employ in this class?

ABCDF	74%
ABCD/No credit	15
ABC/No credit	6
Pass/Fail	1
Pass/No credit	3
No grades issued	0
Other	5

14. For each of the following out-of-class activities, please indicate if attendance was required, recommended or neither.

	Attendance required for course credit	Attendance recommended but not required	Neither required nor recommended
a. On-campus educational type films	5	25	61
b. Other films	3	22	65
c. Field trips to industrial plants, research laboratories	4	17	68
d. Television programs	1	32	56
e. Museums/exhibits/zoos/arboretums	2	11	74
f. Volunteer service on an environmental project	0	8	78
g. Outside lectures	2	29	59

14. (Continued)

	Attendance required for course credit	Attendance recommended but not required	Neither required nor recommended
h. Field trips to natural formation or ecological area	3	8	76
i. Volunteer service on education/community project	1	12	75
j. Tutoring	1	39	50
k. Other	1	2	1

15a. Was this class conducted as an interdisciplinary course?

Yes	10%
No	89

b. If Yes: Which other disciplines were involved? _____

_____

16. Were instructors from other disciplines involved?

	YES	NO
..in course planning?	52	46
..in team teaching?	8	89
..in offering guest lectures?	14	84

17 ich of these types of assistance were available to you last term?

b. Which did you utilize?

	a. Assistance was available to me in the following areas	b. Utilized
a. Clerical help	82	69
b. Test-scoring facilities	53	25
c. Tutors	51	36
d. Readers	11	5
e. Paraprofessional aides/instructional assistants	18	14
f. Media production facilities/assistance	65	38
g. Library/bibliographical assistance	64	34
h. Laboratory assistants	25	20
i. Other	2	2

18. Although this course may have been very effective, what would it take to have made it better?

	Percent
a. More freedom to choose materials	9
b. More interaction with colleagues or administrators	18
c. Less interference from colleagues or administrators	4
d. Larger class (more students)	8
e. Smaller class	29
f. More reader/paraprofessional aides	13
g. More clerical assistance	17
h. Availability of more media or instructional materials	36
i. Stricter prerequisites for admission to class	31
j. Fewer or no prerequisites for admission to class	1
k. Changed course description	6
l. Instructor release time to develop course and/or material	38
m. Different goals and objectives	4
n. Professional development opportunities for instructors	25
o. Better laboratory facilities	21
p. Students better prepared to handle course requirements	53
q. Other	10

19. How many years have you taught in any two-year college?

a. Less than one year	4
b. 1-2 years	9
c. 3-4 years	18
d. 5-10 years	38
e. 11-20 years	27
f. Over 20 years	4

20. At this college are you considered to be a:

a. Full-time faculty member	79
b. Part-time faculty member	16
c. Department or division chairperson	7
d. Administrator	1
e. Other	2

21. Are you currently employed in a research or industrial position directly related to the discipline of this course?

Yes	10
No	89

22. What is the highest degree you presently hold?

a. Bachelor's	8
b. Master's	74
c. Doctorate	15

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JUL 27 1979

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